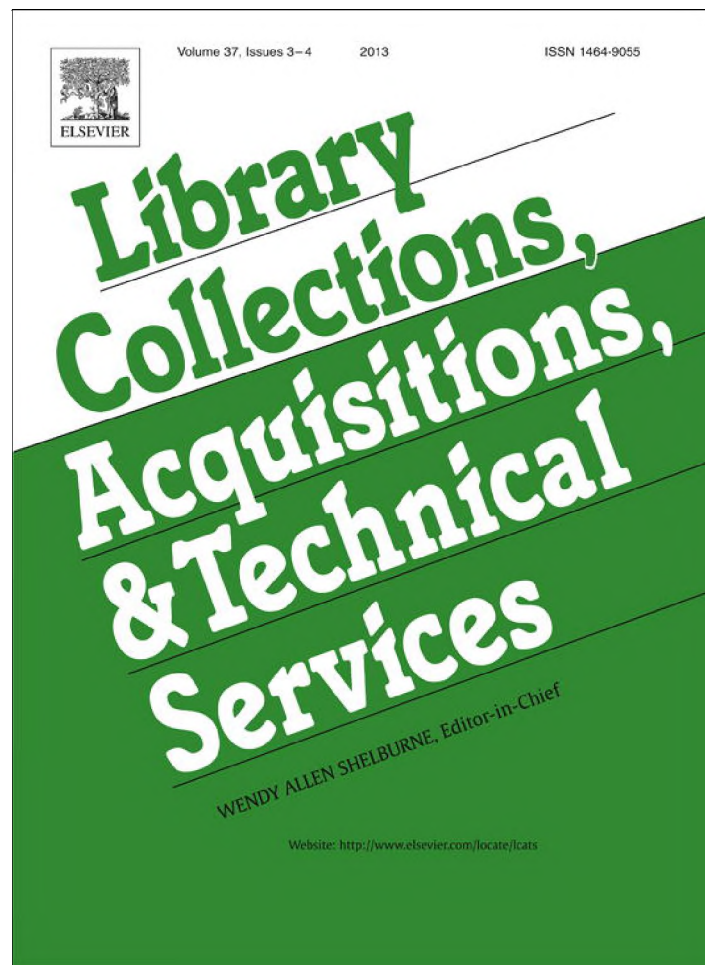


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Impact of the consumption of electronic contents on research productivity in the universities of Castile and Leon

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ABSTRACT

The aim of this study is to investigate the link between the use of electronic resources and the academic output of researchers in the state universities of Castile and Leon (Spain) in the period 2006 to 2011. An analysis was undertaken of the consumption of contents distributed to the Universities of Burgos, Leon, Salamanca and Valladolid by three multidisciplinary suppliers whose materials are widely used: ScienceDirect, SpringerLink and Wiley. In investigating academic output, the databases Web of Science (WoS) from Thomson Reuters and Scopus from Elsevier were taken into account. The consumption of electronic academic contents at the four universities shows an upward trend over the years considered. There is an undoubted preference for titles distributed by ScienceDirect, striking in all the institutions. The study confirms that academics from the areas of science and technology were the most frequent users. The field of Chemistry registered the highest rates of both consumption and academic production, followed at some distance by publications related to Food Science and Technology, in respect of preferred title use, and by Physics with regard to communication of research results. Many of the journals selected for publications belonged to the suppliers investigated. Nevertheless, the work showed no absolute direct correlation between titles selected for academic publication and titles used from the platforms analyzed.

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1. Introduction

The provision of information is one of the essential infrastructures in a research culture. Access to digital content is a priority in any national scientific policy and has to be spearheaded by those institutions which have a tradition of organization and diffusion of contents: the present-day electronic libraries.

Following the trend seen in other countries, Spanish university libraries have grouped themselves into consortia with the aim of optimizing their budgets. These consortia have involved themselves in joint negotiation of licenses for electronic resources, allowing the acquisition of digital contents – primarily journals – although in recent years collections have been enriched with packages of electronic books, some distributed by the same suppliers that provide journals.

Now that the main consortia have been operational for a sufficient period, it is appropriate to start working along various lines of study, particularly when facing budget restrictions in the current harsh financial climate. For the majority of journal packages, the contracts were on a “Big Deal” basis, aimed specifically at consortia, to which new additional titles, or even the complete catalog of the publisher, are offered at very attractive prices. This model certainly presents the opportunity for a spectacular increase in the accessibility of academic information, breaking away from the former tendency for there to be continuous cut-backs in libraries' collections of periodicals; however, it is a model that could very well be revised, both by publishers and by libraries. Regardless of any

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specific model for contracts that may arise from this in the near future, the economies of scale provided by subscriptions to packages of contents are very striking, but do not alter the fact that investments in electronic resources by universities are very large.

The expenditure by libraries in paying for licenses for access to electronic resources is considerable and this is observable on an international scale. Bleiler and Livingston (2010) pointed out in the report of the Association of Research Libraries [ARL] that, in 2008–2009, university libraries spent more than 741 million dollars on electronic resources, while in the CIBER study (2009) it was recorded that British universities invested 79.8 million pounds (159.7 million dollars¹) on licenses for access to electronic resources in 2006 and 2007 out of a total expenditure on journals of 100.12 million lbs (200.4 million dollars). In Spain, the outlays on electronic resources by university libraries (Rebiun, 2009) amounted to 65.03 million euro (90.7 million dollars²), an increase over the previous academic year. Over recent years, the libraries of the BUCLE Consortium, constituting state universities in Castile and Leon, have spent approximately half of their total budget on the acquisition of electronic resources, with a steady rise in expenditure ever since 2006³.

From 2010 onwards, budgets have tended to stagnate, as confirmed by the reports presented to the meeting of SELL (2011) held in Oporto: Spanish budget reductions were between 5% and 10% in 2010, which has led mostly to the cancellation of databases; in Italy university budgets have shrunk by 18% on average, primarily affecting the purchase of monographs, subscriptions to thematic databases and journals in paper format and electronic journals not included in big deals; and in Greece the budget shrinkage has reached 50%.

The current economic situation led the International Coalition of Library Consortia [ICOLC] to make certain recommendations in its statement on the global economic crisis and its impact on consortial licenses of June 2010. Among these was a request for publishers to curb prices, so that users could maintain as many resources and licenses as possible, while potential difficulties that fluctuations in exchange rates could cause libraries when they were planning budgets were also highlighted. The coalition of consortia asked for flexibility from providers so that institutions would not be forced into the cancellation of resources, resulting in gaps in future collections. The route to be followed seemed to be the provision of tailor-made packages for libraries and the offering of options for annual contracts with bi-annual or quarterly payments, while contracts running over several years and incorporating fixed prices, or even reductions, were also suggested. It seems, therefore, that the Big Deal model is entering a phase of crisis.

It is in this context that any evaluation of collections, whether paper or electronic, must be set. This is also true of any assessment of the value for money of investments, and of user satisfaction. This line of research can be followed through the overviews of the literature undertaken by Tenopir (2003) and Rowlands (2007). In recent years, analysis of the statistical data for downloads provided by aggregators has been complemented by studies of user behavior, based on investigation of log-files and data gathered in surveys. Of particular note is the work done by the CIBER research group, under the leadership of Nicholas in the United Kingdom and by Tenopir in the United States. Outside the English-speaking world, noteworthy work has been undertaken by Gargiulo (2003), Rogani (2007), and Boukacem-Zeghmouri and Schöpfel (2008).

In Spain there have been studies of users in specific thematic areas, but few overall analyses of the consumption of electronic information on the part of the Spanish academic community. The limited number of over-arching studies includes research done by Urbano (2004), Urbano et al. (2004), Borrego (2005), Borrego and Urbano (2007), Borrego et al. (2007), Termens (2008), and Ollé and Borrego (2010) on the use of electronic journals in the Consortium of University Libraries of Catalonia [CBUC], together with the investigations of the University of Leon research group. This research team in Leon [CONDOR] has undertaken various studies⁴ looking into the consumption of electronic information in universities in north-western Spain based on downloads statistic of articles from the principal suppliers with a presence in Spanish libraries. This quantitative approach has been complemented by an interest in studying the habits of consumption of electronic information with the qualitative method of surveys. Similarly, the CONDOR group has made a start with investigating the value for money of investments in electronic resources in the universities of Leon and Vigo, linking data on the consumption of electronic information with the costs of the packages of journals to which subscriptions were held (Rodríguez Bravo & Alvite Díez, 2011).

Work undertaken by researchers from the Department of Library and Information Science, University of Leon observed a continuous growth in the consumption of electronic information by the academic communities of north-western Spain from 2002 onwards. This upward trend has been seen in all usage studies carried out in different fields. An example of this is the data recorded by the Society of College, National and University Libraries [SCONUL] in 2008, based on the use of electronic journals in 67 universities in the United Kingdom (CIBER, 2009): downloads were seen to have doubled in three years, with an annual growth rate of 21.7% between the 2003–2004 and 2006–2007 academic years.

In parallel with the investigation of consumption, which evaluates the real demands of users through an analysis of usage statistics and studies' changes in what is on offer and alternative routes to the Big Deal model, it is essential to look at the return on investment in greater detail. On this point, it is of interest to consider the inter-relationship between consumption of academic contents and output by researchers.

¹ The exchange rate for the UK pounds sterling in U.S. dollars, according to the data provided by the Bank of England (<http://www.bankofengland.co.uk>) was in 2007: US\$2.0022.

² The exchange rate for the euro in U.S. dollars, according to the data provided by the European Central Bank (<http://www.ecb.int>) was in 2009: US\$1.3948.

³ Consultation of statistical data from Rebiun. Accessible on: http://estadisticas.rebiun.org/cuestionarios/indicadores/indicadores_main.asp.

⁴ Value for money of investments in electronic journals in the university libraries of Castile and Leon (LE013A11-2). Lead researcher: Dr. Blanca Rodríguez Bravo. Project funded by the Castile and Leon Regional Government (2011–2012).

With regard to the research productivity of academic institutions, several groups of Spanish researchers have investigated academic production in Spain, largely through bibliometric indicators. Mention must be made of the work by the Spanish Institute for Information Studies of Science and Technology [IEDCYT], which looked at Spanish scientific and technological output in the period 1996 to 2001 (Gómez Caridad et al., 2004), as well as output specifically from researchers at the Spanish Higher Scientific Research Centre [CSIC] over the period 2006–2010 (Gómez Caridad et al., 2011). Likewise, work done at Carlos III University which investigated academic collaboration in Spanish output between 2000 and 2004 (Olmeda Gómez et al., 2006) should be noted. Of similar interest were the contributions made by the Science and Scientific Publishing Assessment Group [EC3] at the University of Granada (Delgado López-Cozar, Jiménez Contreras, & Ruiz-Pérez, 2009), which took as their point of reference the database of the Web of Science (WoS), and those of the Scimago group, based on the same database, and on Scopus (de Moya Anegón et al., 2007, 2010). Similarly, the research group in Leon started an analysis of the academic output of researchers at the University of Leon⁵.

The research project mentioned looked at the visibility of the academic output of researchers at this university between 1995 and 2006. One of the more striking results was the discovery of 43 titles in the WoS and Scopus databases with more than ten contributions and the presence among them of several journals from Elsevier, which were among the most downloaded journals from this distributor. Specifically, they were six of the 17 journals most frequently downloaded at this university in 2005 (Rodríguez Bravo & Alvite Díez, 2006). Similarly, eleven of the journals most often used in this institution from 2006 to 2009 appeared, among them six of the top seven by articles downloaded, which would appear to indicate that there is a correlation between the journals preferred for consumption and those in which researchers choose to publish their work. There are similar correlations between the titles selected for communicating the results of research and the most frequently used journals from other suppliers like SpringerLink and Wiley (Rodríguez Bravo, Alvite Díez, & Barrionuevo Almuzara, 2012).

Studies of academic output note an increase in the Spanish production of academic literature in recent decades (González Alcaide, Valderrama Zurián, & Alexandre Benavent, 2012). This reflects positive growth rates in scientific and technological research in every year from 1980 to 2007, and an increase in the number of texts published, which went from 3761 in 1980 to 36,039 in 2007. This growth put Spain in ninth place in the world for academic output, according to data from Thomson Reuters for 1998 to 2008. With regard to the universities studied in this present work, in the overall ranking for research output of state universities, which covers 48 institutions, Salamanca was the best placed, coming in twenty-fifth position. In terms of international scientific impact [ISI] articles published by staff, Salamanca was once more the best positioned, coming in thirty-fourth place, top among the four state universities in the Castile and Leon Region investigated (Buela-Casal et al., 2010).

For its part, the work by de Moya Anegón et al. (2010), which looked into Spanish scientific output recorded in the Scopus database, found that individual institutions contributed the following proportions of total Spanish scientific research output between 2003 and 2008: University of Burgos, 0.34%; Leon University, 0.64%; University of Salamanca, 1.76%; and Valladolid University. More recent work by de Moya Anegón et al. (2013) identified the Universities of Salamanca and Valladolid among the thirty institutions with the highest output between 2006 and 2010, ranking 19th and 22nd respectively. Over this period the Castile and Leon Region contributed 4.78% of total Spanish academic output.

On the basis of the data noted above, the purpose of this current work was to investigate the link between the use of electronic resources and the output of researchers in the state universities of Castile and Leon. An initial piece of research was undertaken, focused on the correlation between consumption and output at the University of Vigo, which allowed a trial of the proposed methodology (Rodríguez Bravo et al., 2012). As was indicated by the Association of College and Research Libraries [ACRL] (2010), an analysis of the use of resources is of no significance if it is not linked to results in the shape of learning by students and output by researchers. The interest lies in measuring the impact of a library on its clients.

2. Objectives and methods

Analysis was undertaken of the consumption of contents distributed to the Universities of Burgos, Leon, Salamanca and Valladolid by three multidisciplinary suppliers, whose materials are widely used: ScienceDirect, SpringerLink and Wiley. It can be assumed that by the period under study, 2006 to 2011, the model for subscribing to packages of electronic journals had been consolidated. In investigating academic output, the databases Web of Science (WoS) from Thomson Reuters and Scopus from Elsevier were taken into account.

The specific aims pursued were the following:

- An evaluation of changes in the consumption of electronic information in the years under consideration and their correspondence with academic output.
- An analysis of the concentration and dispersion of use of contents on the basis of downloads of articles.
- An investigation of preferences for specific journals.
- Arriving at conclusions as to the relevance of the packages of journals used.
- A comparison of which journals were most often consulted by the academic communities of the state universities in Castile and Leon with the titles they preferred for the publication of their research results.
- An assessment of the correspondence between titles preferred for use and their academic prestige.

⁵ International visibility of science and technology output at the University of Leon, 1995 to 2006. Lead researcher: Dr. María Antonia Morán Suárez. Project funded by the Provincial Council of Leon (2008–2009).

- Identification of the academic disciplines most active in the use of electronic information and in the communication of research outcomes.

The data concerning research personnel included all academic staff, whether full-time or part-time. Data relating to students was not considered, since the relevant literature concludes that the greater proportion of downloads is by academic staff. On this point, [Tenopir and King \(2000\)](#) indicated that 75% of the use of electronic publications had as its purpose the undertaking of research activity, whilst 41% was connected with teaching.

2.1. Consumption of information

Data was provided by suppliers of electronic journals to the libraries of the state universities of Castile and Leon over the period 2006 to 2010 in the form of annual Excel files detailing the number of downloads of full text articles each month, broken down journal title.

The indicators established for this analysis were:

- a) Downloads of articles
 - Annual changes in downloads per supplier.
 - Ratios of consumption per 100 researchers.
- b) Titles used
 - Yearly changes in titles accessible, titles used, and core titles.
 - Rates of dispersion and concentration of use.
 - Representativeness of the most popular titles among the total downloads.

The core is made up of journal titles with ten or more downloads in a year. The relationship between titles used and titles accessible gives the dispersion rate. The relationship between core titles and titles used yields the rate for concentration of use. The representativeness of the titles forming the top twenty-five among the total set of downloads was identified.

2.2. Analysis of output

In January 2013 information was extracted from the databases Web of Science and Scopus in respect of the production of publications by the university communities of Burgos, Leon, Salamanca and Valladolid over the period 2006 to 2011. The search term “univ*” was used, together with the name of the corresponding institution in the address and affiliation fields. The search was limited to journal articles, and took into consideration only those titles with more than two articles published. The journal titles found in the two databases were checked against the titles used.

The indicators established were:

- a) Production
 - Yearly changes in articles published by the academic communities of the Universities of Burgos, Leon, Salamanca and Valladolid.
 - Annual rate of growth in academic output.
 - Productivity ratios per 100 research staff.
- b) Correspondence between production and consumption
 - Comparison of the ranking of journals with the largest accumulated output and the ranking of journals most used for reading.
 - Representativeness of the titles included in the packages studied within the set of titles preferred for publishing.
 - Relevance of publications in Journal Citation Reports [JCR].
 - Assignment of journals to academic fields.

The period analyzed for consumption and production started in 2006 and ended in 2010, since this was the last year for which libraries had statistics available at the time the work was undertaken. The time span included 2011 for the publication of research results, partly because the process of construction of knowledge based on previous research requires a longer period, and partly because this permitted the presentation of more up to date output data.

3. Results and discussion

The results are presented in two blocks, corresponding to the two parameters established in the methodology.

3.1. Consumption of information

Changes in downloads from the multidisciplinary distributors ScienceDirect, SpringerLink and Wiley in the four universities of the Castile and Leon Region were determined ([Table 2](#)).

The figures obtained were varied, as a consequence of the differing populations of academic staff in the universities under study. This may be observed in [Table 1](#).

Table 1
Academic staff*

Universities	2006	2007	2008	2009	2010	2011
University of Burgos	676	701	688	718	727	739
University of Leon	943	955	950	988	1093	1039
University of Salamanca	2358	2401	2453	2485	2483	2468
University of Valladolid	2558	2615	2514	2574	2918	2863

* Data obtained from the database of the Spanish National Institute for Statistics [INE].

It may be seen that there was continuous growth in the consumption of electronic information, observable from the very start of subscriptions with the suppliers investigated. Thus, the first data for the University of Burgos in 2002 show the number of downloads as 11,833, while in Leon the first available figure is for the year 2003 and was 50,973 downloads. In the case of Valladolid downloads from ScienceDirect and SpringerLink in 2002 together came to 33,008, while in the following year they reached 56,705 (Rodríguez Bravo & Alvite Díez, 2011) (Fig. 1).

The University of Burgos showed a moderate but steady growth in the number of downloads. In contrast, the other universities presented yearly oscillations and variations which were significant in some cases, such as the University of Leon.

The suppliers studied distribute a considerable number of journals, so that the universities analyzed had access to more than 2000 titles in the case of ScienceDirect and SpringerLink; however, Wiley offered significantly fewer than this number (Appendix A).

The number of titles accessible was similar in the four universities studied, though slightly higher at the University of Valladolid. It is noteworthy that a difference was observable in the numbers of titles used and core titles (publications with more than ten downloads a year) in the larger universities as opposed to those of smaller size.

In 2010 Burgos and Leon showed a large number of titles that were not accessed at all, while the figures for journals with more than ten downloads per year were small. At the University of Burgos, the number of journals not used was greater than the total of titles actually utilized. The opposite extreme was seen at the University of Salamanca, whose core titles were more numerous than the figure for titles left unused. The percentages of titles not used varied between 29.86% in the case of the University of Salamanca and 54.99% at Burgos. The University of Valladolid had a percentage of unused journals that was 38.52%, while in Leon this figure reached 48.03%.

As mentioned above, a distinction was made among the total journals downloaded of the number of journals receiving moderately intense use, with the threshold being set at ten or more downloads in a year. The ratio of journals most often downloaded, which form the core of the collection, to the total number of journals downloaded was employed to estimate the concentration rate (Appendix A).

This work focused on one part of the core: The 25 journals with the largest number of downloads in the years and at the institutions studied, as presented in Table 3.

Clearly, the representativeness of the Top 25 titles within the total downloads at the four universities was considerable, in view of the fact that they were generally under 1% of the total of titles for which contracts were held. Specifically, relative to the titles accessible in 2010, the proportion for these most often downloaded journals was 0.36% at the University of Valladolid, 0.37% in Leon, 0.38% at the University of Salamanca and 0.41% in Burgos. These figures corroborate the fact that there is a considerable concentration of use circumscribed to a very limited number of titles.

It can be observed that it was the University of Burgos which showed the greatest preference for a restricted number of journals, having a percentage of downloads of preferred titles that was over 30% in all years analyzed. The opposite extreme was the University of Valladolid, where the percentage of downloads of the most often used journals did not reach 20% in any of the years studied. In Leon and Salamanca, larger year-on-year oscillations were seen.

In order to assess the match between what is on offer and the actual preferences of users, it is essential to discover which titles are used within the overall total of accessible journals. The relationship between titles downloaded and titles accessible yields the dispersion rate.

Table 4 shows the flexibility of subscribed content use that is encouraged by the wide availability of titles in packages under contracts of the Big Deal model. Nonetheless, the differences between the various distributors are striking, and a preference for the contents distributed by ScienceDirect can be observed in all the universities studied; in every year, more than 50% of the contents distributed by this supplier were used.

Table 2
Annual downloads per university.

Universities	2006	2007	2008	2009	2010
University of Burgos	41,088	45,032	55,967	58,331	72,049
University of Leon	73,218	80,214	125,337	74,152	100,312
University of Salamanca	144,660	122,906	136,354	136,356	198,225
University of Valladolid	133,164	132,629	148,908	171,921	180,642

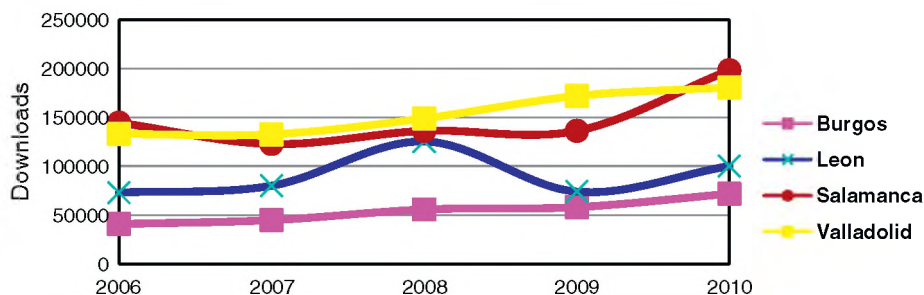


Fig. 1. Changes in yearly downloads at each University.

In respect to the other two distributors considered, there was generally a greater relative use of the Wiley package. This seems to be an outcome of its smaller size when compared with the packages of competitors, with a relatively limited number of journals being distributed by this supplier up until 2010 (Appendix A).

The extent of dispersion seems to be confirmed in the pioneering studies by Tenopir and King (2002) based on surveys of American academics. These authors stated that such professionals not only read more articles than in the past, but also read a broader range of titles, in an attempt to cover a spectrum of information similar to what they accessed before having contracts for packages available.

As shown in Fig. 2, a subscription to ScienceDirect was essential for the academic communities studied, since this covered a considerable portion of their requirements for academic contents. This is also corroborated in Table 6 which shows the Top 25 titles used by preference.

This data concurs with what was found in France by Boukacem-Zeghmouri and Schöpfel (2008). These authors indicated that the use of the package from Elsevier amounted to 78% of the total of downloads.

3.2. Correspondence between output and consumption

This section investigates the relationship between downloads of articles and academic output. Table 5 shows the correspondence between consumption and production per 100 researchers.

As has already been explained, ratios of use are approximate, in view of the fact that no account has been taken of possible downloads by students. In light of the similarity of the figures from Scopus and WoS, productivity ratios were calculated exclusively with the figures from the Thomson Reuters database.

The usage ratios noted were greater in the smaller universities, Burgos and Leon, with very high percentages in some years, the extraordinary surge in downloads in Leon in 2008 being a prime example. In fact, the ratios were above 50 downloads per researcher in all the institutions. These relatively high use rates in the smaller universities contrast with the figures for total downloads and overall usage of the set of titles covered by contracts.

According to a study by CIBER (2009), which investigated the Elsevier package during the 2006–2007 academic year in ten research institutions in the United Kingdom, the average number of downloads per researcher was 47 articles. This figure was exceeded in the universities considered here.

In a previous study, ratios for downloads of articles per researcher corresponding to ScienceDirect were determined, and it was noted that at the University of Leon the figure was around 60 downloads (Rodríguez Bravo & Alvite Díez, 2011). These results are compatible with those noted, taking into account downloads from the three suppliers observed here, and they suggest a significant growth in the ratio for the University of Leon.

In respect of the ratios of academic production in the universities analyzed, higher averages were observed in the Universities of Leon and Salamanca, exceeding the figure of 20 articles for each 100 researchers. Valladolid went above this threshold in the last three years considered, whilst Burgos remained below the threshold in all years.

As for the growth rates of academic output (Appendix B, Tables B.1 and B.2), irregularities may be noted in the years studied; however, an overall increase in articles published, both in WoS and in Scopus, was unquestionable in all the institutions over the period studied.

Table 3
Representativeness of the Top 25 preferred titles among total downloads.

Universities	2006	2007	2008	2009	2010
University of Burgos	15,200 36.99%	15,394 34.18%	18,847 33.67%	18,945 32.47%	21,790 30.24%
University of Leon	17,091 23.34%	17,945 22.37%	20,048 15.99%	21,710 29.27%	15,277 15.22%
University of Salamanca	-	27,703 22.53%	31,727 23.26%	34,282 25.14%	27,052 13.61%
University of Valladolid	-	24,980 18.83%	29,158 19.58%	21,110 12.27%	34,719 19.21%

Table 4
Dispersion rate (percentage) by distributors.

Distributors	2006			2007			2008			2009			2010		
	SD	SL	W	SD	SL	W	SD	SL	W	SD	SL	W	SD	SL	W
University of Burgos	60.61	23.16	31.39	59.90	12.01	29.17	56.71	18.20	35.70	57.08	17.29	20.11	81.12	27.57	33.46
University of Leon	65.34	18.96	48.26	68.53	20.27	46.67	78.12	24.41	45.79	64.62	22.24	43.22	71.31	34.03	31.36
University of Salamanca		69.01	63.84	71.91	100.00	69.93	76.66	57.15	59.56	78.81	39.53	44.12	83.83	52.60	78.71
University of Valladolid	70.84		66.78	72.21	43.40	60.79	75.13	51.47	58.11	75.24	55.63	56.37	89.36	47.61	50.31

SD = ScienceDirect; SL = SpringerLink; W = Wiley.

Table 6 presents the top-ranked journals, which are those found in the Top 25 in at least two universities on the basis of total downloads recorded between 2006 and 2010. To establish these, all titles present in the Top 25 of each university across all years were identified.

It can be observed that a large percentage of the preferred titles came from ScienceDirect, a fact that confirms the crucial role of this distributor in the universities studied. The titles distributed by Wiley came in second place.

There was no title common to all four institutions. Staff at the University of Valladolid had preferences which were mostly shared with those at the Universities of Burgos and of Salamanca. The outlier of the group was the University of Leon, with more idiosyncratic reading profiles than the other universities in the region, directed towards a use of contents primarily in veterinary sciences. Nonetheless, among the titles given preferential use by the academic community in Leon there were journals with a considerable number of downloads in several of the years studied, such as *Analytica Chimica Acta* and *Bioresource Technology*, which were noted as priority titles in other universities in the BUCLE Consortium.

At the University of Salamanca alone there were three titles which accumulated more than 10,000 downloads between 2006 and 2010. These were three publications distributed by ScienceDirect. The most downloaded titles at the universities of Castile and Leon were: *Angewandte Chemie International Edition*, *Food Chemistry*, *Journal of Chromatography A*, *Tetrahedron* and *Tetrahedron Letters*.

Taking as a reference the impact factor (IF) over the last five years (Five-Year Impact Factor) from Journal Citation Reports (JCR), all the journals listed in Table 6 had an IF greater than 1.413, which was the figure for the *Journal of Applied Polymer Science*. The journals with the greatest impact factor were *Angewandte Chemie International Edition*, whose IF was 13,195, and *Advanced Materials* with 12,813, both distributed by Wiley. Next in the ranking was the sole social sciences journal in the table, *Strategic Management Journal*, with an IF of 6288. This publication is also distributed by Wiley.

Table 7 presents titles which were accessed in at least two of the universities studied and appeared in all the years considered with more than two articles recorded in WoS and/or Scopus.

These comprised 17 titles, of which seven were from ScienceDirect and the remainder from academic associations, among which the most noteworthy were five from the American Chemical Society (ACS). As in Table 6, more frequent agreement was to be observed between the Universities of Burgos, Salamanca and Valladolid. In the case of Leon, just three titles from ScienceDirect were found in the table and none of them coincided with those selected in the table of journals preferred for use.

All the publications in Table 7 are distributed in electronic format; as was pointed out by Cox and Cox (2010), the dominance of electronic versions in the distribution of journals is unquestionable. They noted that in 2008 an average of 99.6% of the titles from major publishers were available online, with even small publishers offering a far from negligible 88% of their contents in electronic format.

The journals listed in Table 7 had a lower average five year IF than the titles shown in Table 6. The IFs varied from the 5.352 of *Bioresource Technology* distributed in the package from Elsevier to the 1.344 of the *Journal of Physics A Mathematical and Theoretical* distributed by IOPScience.

There were four titles which correspond with the selection presented in Table 6, showing journals most often read at the four institutions. These were *Analytica Chimica Acta*, *Bioresource Technology*, *Food Chemistry* and *Journal of Chromatography A*, all four titles distributed by ScienceDirect.

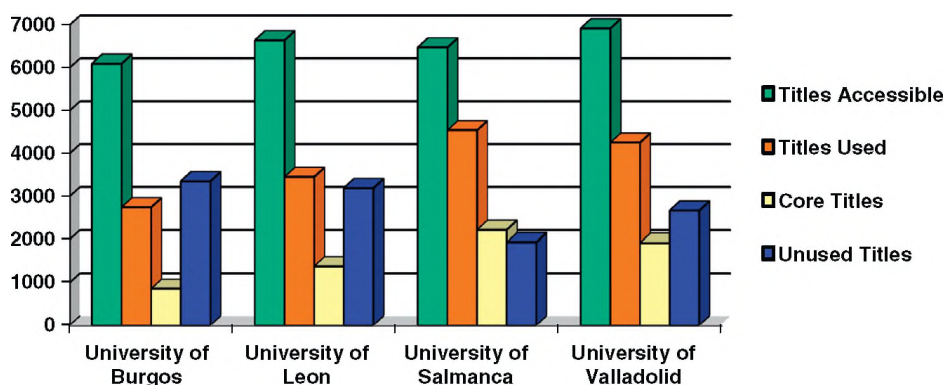


Fig. 2. Consumption data for 2010.

Table 5

Ratios of use and academic output in WoS per 100 research staff.

Universities	2006		2007		2008		2009		2010	
	Use	Output	Use	Output	Use	Output	Use	Output	Use	Output
Burgos	6078.10	14.20	6423.96	18.83	8134.73	17.00	8124.09	15.87	9910.45	17.88
Leon	7764.36	23.43	8399.37	26.59	13193.36	26.63	7505.26	26.51	9177.67	22.78
Salamanca	6134.86	23.62	5118.95	24.28	5558.66	28.57	5487.16	26.39	7983.28	28.99
Valladolid	5205.78	18.96	5071.85	18.31	5923.15	23.62	6679.13	22.84	6190.61	20.11

Angewandte Chemie International Edition did not appear among the titles surpassing the threshold established in the previous table. Nonetheless, the WoS and Scopus databases covered articles published in that journal by the Universities of Burgos and Valladolid. Specifically, in Burgos, a total of four articles were noted in WoS and three in Scopus, whilst in Valladolid seven articles appeared in WoS and six in Scopus between 2006 and 2011.

Consideration of the subject areas to which titles were assigned in JCR showed that they belonged mostly to the fields covered by science and technology. In both tables, there is a clear predominance of contents from the field of chemistry, with this subject accounting for approximately 40% of publications preferred for reading and for publication.

Among the journals listed in Table 7, second place goes to titles with contents related to physics and then to those from food science and technology. This last field also stands out in the table of titles preferred for reading. It should be stressed that Table 6 includes a journal devoted to business management. As has already been pointed out, this is the only publication from the field of social sciences.

Fig. 3 shows the most represented suppliers of electronic journals from which more than two articles were listed in WoS in the years considered. A clear preference for ScienceDirect can be observed in all the universities investigated.

At the University of Burgos, among the titles from which more than two articles figured in WoS there were thirty titles from ScienceDirect, twelve from Wiley, four from SpringerLink, ten from ACS and two from Taylor and Francis; at the University of Leon, of the 149 titles selected, fifty journals were distributed with the Elsevier package, eighteen by SpringerLink, sixteen titles by Wiley, five titles belonged to Taylor and Francis, and one to ACS; at Salamanca, there were 126 titles from ScienceDirect, 38 from Wiley, 35 from Springer, three from IEEE Xplore, six from Taylor and Francis, twelve from ACS and thirteen from IOPScience; and at the University of Valladolid, 129 titles belonged to ScienceDirect, 29 to SpringerLink, 33 titles to Wiley, nine titles were from Taylor and Francis, seven from IEEE Xplore, ten from IOPScience and sixteen titles from ACS (Fig. 4).

Apart from the distributors specifically considered in this study, who dominate the market, a predilection may be observed for ACS and Taylor and Francis. It is also noteworthy that, in the two universities of greater size, there was a preference for publication

Table 6

Shared titles preferred for use.

Title	SUPPLIER	UBU	ULE	USAL	UVA
Advanced Materials	Wiley	515	–	–	744
Analytica Chimica Acta	ScienceDirect	6012	–	5021	4407
Analytical And Bioanalytical Chemistry	Springer	788	–	995	–
Angewandte Chemie International Edition	Wiley	5252	–	7665	7166
Applied Microbiology And Biotechnology	Springer	–	1441	1120	697
Biochemical And Biophysical Research Communication	ScienceDirect	–	2661	5837	–
Bioresource Technology	ScienceDirect	2380	–	–	6533
Biotechnology And Bioengineering	Wiley	–	574	–	1057
Chemistry-A European Journal	Wiley	2425	–	2219	3413
European Food Research Technology	Springer	682	–	968	527
European Journal of Inorganic Chemistry	Wiley	931	–	–	984
European Journal of Organic Chemistry	Wiley	1429	–	2146	1388
Fluid Phase Equilibria	ScienceDirect	2551	–	–	6297
Food Chemistry	ScienceDirect	7951	–	5311	7728
Forest Ecology and Management	ScienceDirect	–	3251	–	6201
Journal of Applied Polymer Science	Wiley	822	–	–	2087
Journal of Chromatography a	ScienceDirect	4857	–	10,713	5570
Journal of Membrane Science	ScienceDirect	3575	–	–	4905
Journal of the Science of Food and Agriculture	Wiley	819	788	–	–
Strategic Management Journal	Wiley	905	–	–	989
Tetrahedron	ScienceDirect	3907	–	13,517	4224
Tetrahedron Letters	ScienceDirect	5794	–	10,019	4840
Water Research	ScienceDirect	–	3054	–	3698

UBU = University of Burgos; ULE = University of Leon; USAL = University of Salamanca; UVA = University of Valladolid.

Table 7

Shared titles preferred for publication.

Title	UBU		ULE		USAL		UVA		Supplier
	WoS	Scopus	WoS	Scopus	WoS	Scopus	WoS	Scopus	
Analytica Chimica Acta	17	15			17	13			ScienceDirect
Bioresource Technology			15	15			16	16	ScienceDirect
Food Chemistry	12	12			18	18			ScienceDirect
Industrial and Engineering Chemistry Research	7	10			^a	15	15	16	American Chemical Society
Inorganic Chemistry	6	6					20	19	American Chemical Society
International Journal of Food Microbiology	6	6	12	13					ScienceDirect
Journal of Agricultural and Food Chemistry	8	8			15	14			American Chemical Society
Journal of Applied Physics					37	33	16	15	American Institute of Physics
Journal of Chemical and Engineering Data	9	9					22	21	American Chemical Society
Journal of Chemical Physics					^a	13	37	39	American Institute of Physics
Journal of Chromatography A					21	21	18	16	ScienceDirect
Journal of Physical Chemistry A	6	6					21	24	American Chemical Society
Journal of Physics A Mathematical and Theoretical	10	10					20	18	Institute of Physics Publishing (IOPScience)
Meat Science	9	8	14	12					ScienceDirect
Physical Chemistry Chemical Physics	5	6					18	17	Royal Society of Chemistry
Physical Review B Condensed Matter and Materials Physics	6	5			27	25	46	45	American Physical Society
Talanta	10	7			^a	13			ScienceDirect

UBU = University of Burgos; ULE = University of Leon; USAL = University of Salamanca; UVA = University of Valladolid.

^a Only in Scopus. Did not get past the cut-off point for ISI.

through the packages IOPScience and IEEE Xplore. At the University of Salamanca, the selection included two titles in social sciences distributed by Emerald, *Management Decision* and *Online Information Review*.

The University of Leon was the only institution which displayed a preference for titles from SpringerLink over Wiley. It should also be noted that at this institution there was scant use of journals from ACS. In contrast, the relevance of this package was especially significant at the University of Burgos. These peculiarities are related to the fact that there is no specific degree in chemistry at the Leon University, and so only a limited number of researchers at that university in this sector of science, which is of considerable weight at the other three institutions (Fig. 5).

The academic communities studied showed a preference for publishing in titles distributed by the suppliers considered in this work. It would seem that the ease of access to electronic journals and the visibility offered by these distributors' platforms contribute to the choice of their titles for communicating research results. As can be seen from the graph, even the output of the University of Salamanca, despite a slightly lower percentage than the others, is published largely in journals from these packages.

4. Reflections

The Big Deal model for access to electronic information has proved to have a positive impact in the institutions investigated, and has translated into a greater consumption of academic contents, encouraged by the much bigger range of titles on offer and the ease of access to them, which characterizes these journal platforms. The consumption of electronic academic contents at the four universities, despite a few variations, shows an upward trend over the years considered. This growth has been continuous since the beginning of subscriptions to packages (Rodríguez Bravo & Alvite Díez, 2011). This upward tendency is to be noted in all the studies of usage that have been undertaken.

In absolute number of downloads, the academic communities of Salamanca and Valladolid showed a consumption trend that was more intense and flexible than was observed in the Universities of Burgos and Leon. This is consistent with the larger numbers of potential users of packages of the former institutions.

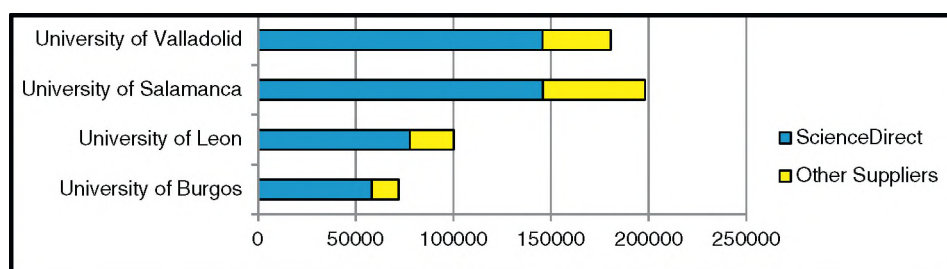


Fig. 3. Downloads from ScienceDirect relative to total downloads in 2010.

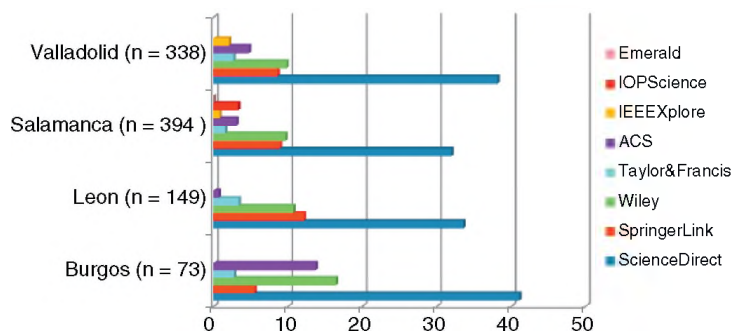


Fig. 4. Representativeness in packages of the journals used by preference for publications (WoS).

There is an undoubted preference for titles distributed by ScienceDirect in all the institutions. The four universities use a considerable part of the titles included in this package, some of them with noteworthy intensity. This is, therefore, an essential subscription in the institutions studied, and even to the international academic community. Note should also be taken of the intensive use of certain titles distributed by Wiley that have a considerable Impact Factor.

Investigations based on usage statistics highlight the flexibility required by users and the benefits provided by the Big Deal model, allowing much greater dispersion of consumption. Doubtless more titles are used than those which were previously held in paper format, even if the main bulk of downloads is from a limited percentage of titles. There is a considerable concentration of use, observed since the start of utilization of electronic journals in studies by Eason, Richardson, and Yu (2000), Davis (2002), Davis and Solla (2003), in work by Nicholas and the CIBER research group (Nicholas & Huntington, 2006), or in more recent investigations by the group of authors of this present article (Rodríguez Bravo & Alvite Díez, 2011; Rodríguez Bravo et al., 2008).

In this study, a persistent selective tendency was visible in the preference for certain journal titles. This is shown by the fact that the top 25 titles preferred for consumption in the institutions under study, in other words between 0.3% and 0.4% of the total titles subscribed to in 2010, met more than 13% of the demand in the University of Salamanca, 15% in the University of Leon and 19% in Valladolid. This rose to more than 30% at the University of Burgos.

It is generally considered that it is science researchers who make most use of electronic publications. Early investigations pointed to physicists, biologists and workers in biomedical sciences as making more use of electronic journals (Tenopir, 2002, 2003) (Rusch-Feja & Siebeky, 1999). More recent studies, such as those undertaken by Tenopir et al. (2005) and Borrego et al. (2007), have confirmed these findings, stressing that the main users of electronic journals were workers in the exact and natural sciences. The cause of this habit is twofold: on the one hand, the subscription packages tend to offer mostly publications relevant to these academic fields; on the other, there is the traditional confidence in journals on the part of researchers in experimental sciences.

As for the concentration of use, it would appear significant that the CIBER project (2011) concluded that there were considerable differences in the number of titles used by researchers, depending on their disciplines: Only 11% of physicists claimed that they read ten or more journals, while for chemists this percentage went up to 53%. On the basis of the surveys conducted by Tenopir and King (2008), it was stated that chemists read an average of 276 articles a year, physicists 204, and engineers 72.

Judging by the number of downloads of articles carried out in the period analyzed, this study confirms that it is academics from the areas of science and technology who are currently the most assiduous users. The sheer amount of activity of teachers and researchers linked to the area of chemistry was especially striking. It is possible to speak of continuity in the preferences for consumption of the universities considered, as can be observed in persistence of preferred titles noted in usage data for 2005 at the Universities of Burgos and Leon (Rodríguez Bravo et al., 2008), which continued to be among the titles most often downloaded to the present day. These were *Analytica Chimica Acta*, *Angewandte Chemie International Edition*, *Food Chemistry* or *Tetrahedron Letters* at the University of Burgos and *Applied Microbiology and Biotechnology*, *Biochemical and Biophysical Research Communication* or *Water Research*, at the University of Leon.

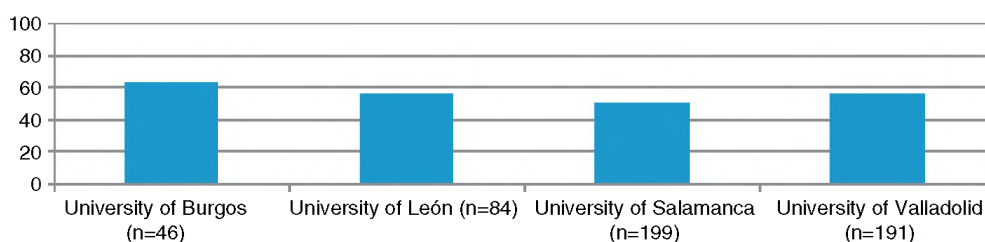


Fig. 5. Representativeness rate for titles included in the packages studied among the set of titles preferred for publication.

A noteworthy overlap could be seen in the patterns of usage at the Universities of Burgos, Valladolid and Salamanca, especially the first two. A distinctive individual profile was observed at the University of Leon, which had already been highlighted in previous work (Rodríguez Bravo et al., 2012). This fact, together with the intensive use falling on just a small set of titles leads to the proposal of studying “à la carte” offers, was suggested by the European Commission (2006), putting forward the view that libraries should have the possibility of selecting groups of publications to make up their own packages of electronic resources. Similar views were expressed by the ICOLC (2010), which asked for flexibility to overcome the rigidity of the Big Deal model and to work towards the construction of collections adapted to the real necessities of universities which have individual profiles and differ in the degree programs they offer and their strengths in the related academic fields.

For its part, the growth in academic output in all the institutions under study was unquestionable, and matched the increases in Spanish production as a whole (González Alcaide et al., 2012). Delgado López-Cozar et al. (2009) noted that the sustained growth of Spanish academic output on a global scale, encouraged by the incentives policy of the Spanish National Commission for Assessing Research Activity [CNEAI] and reflected in the progressive incorporation of Spanish journals into WoS promoted by the Spanish Foundation for Science and Technology [FECYT], is a phenomenon that reaches all scientific areas. In this same study it was highlighted that production in Spain was principally in the following fields: space sciences, agriculture, mathematics, microbiology, chemistry, plant and animal sciences, ecology and environmental sciences, and physics; disciplines with outputs higher than the average rate worldwide.

In both consumption and academic production it was the field of chemistry that has a preponderant position, followed at some distance by publications related to food science and technology, in respect of preferred title use, and by physics with regard to communication of research results. The predominance of chemical publications was also observed in the University of Vigo (Rodríguez Bravo et al., 2012). Bordons et al. (2010) noted that Spanish researchers in the area of chemistry demonstrated a clear preference for publication in international journals and this would seem to translate into the greater visibility of research in this field in the databases studied.

It would appear that the availability of electronic resources contributes to a growth in the academic output of universities. On this point, Tenopir et al. (2009) pointed out that there were appreciable differences in the consumption of information between the most productive academics and the remainder. The most recognized researchers are intensive journal users. In fact, as noted by the CIBER research group (2011), an intensive use of e-journals is a reliable indicator of future research success and this has translated into changes in the model for academic communication: researchers in the United Kingdom produce more articles, with more bibliographic citations and a wider range of sources than two decades ago.

Other pieces of work dedicated to an analysis of the relationships between the provision of contents and the results of research would be those by Oppenheim and Stuart (2004), by the Research Information Network [RIN] (2009), and by RIN and RLUK, Research Libraries UK [RLUK] (2011). The RIN report (2009), based on studies undertaken by the CIBER research group at University College, London, analyzed the use of electronic journals and found a strong correlation between expenditure on electronic journals and downloads. Similarly, it noted certain links between the consumption of electronic journals and research outcomes, among which were connections between the number of articles downloaded and the quantity of originals published in academic journals. RIN and RLUK's (2011) report confirmed the existence of a strong relationship between the levels of use of electronic journals and consequent success in research.

The study presented here showed no absolute and direct correlation between titles selected for academic publication among the top 25 of the universities considered relative to the top 25 titles most used from the multidisciplinary platforms analyzed. This same observation was noted in an earlier study concentrating on the University of Vigo (Rodríguez Bravo et al., 2012).

No data was available on the use of journals preferred for publication that are not included in the platforms investigated, although it may be supposed that they also receive numerous consultations. In any case, the journals selected were publications of acclaim, having impact indices in both WoS and Scopus.

Many of the journals selected for publication belonged to the suppliers investigated and this was particularly true of ScienceDirect. It seems that this fact speaks in favor of the greater visibility of titles supplied in electronic format in the large packages. Similarly, there was a significant preference for communicating research results through the journals published by well-known scientific associations, which sometimes have their own distribution platforms. These include ACS Publications, for the journals of the American Chemical Society, the IEEE Xplore package of the Institute of Electrical and Electronic Engineers, or IOPScience from the Institute of Physics.

It is true that demonstrating that levels of use are a sound indicator of research success does not equate to the establishment of a cause-and-effect relationship between consumption and results in research, as other factors may intervene; however, it does highlight the need to continue investigating on these lines in various universities, or groups of universities, and over a range timescales.

In conclusion, it would appear that usage and value-for-money data are an essential tool for managing and decision making. On this point, there are various pieces of work co-ordinated by Tenopir in which the returns on investments in electronic resources are investigated by studying the contribution made by libraries to achieving the aims of academic institutions, quantifying in this way the impact of the library on the success and positioning of universities as a whole (Tenopir et al., 2010). Indubitably, electronic resources aid library users, especially researchers, to be more productive; they allow them access to more information in a quicker and more convenient way, saving time and effort, permitting them to integrate resources in their articles and to explore interdisciplinary research (Luther, 2008). As was already pointed out in by Wilson et al. (2000), the value of a university library should not be measured exclusively from a financial viewpoint, but also from the perspective of its contribution to the enriching of outcomes for its users.

Appendix A. Data on consumption

Table A.1

Total downloads per supplier at the University of Burgos.

	2006	2007	2008	2009	2010
ScienceDirect	32,590	35,053	46,493	48,417	58,252
SpringerLink	2152	3151	3375	3700	4383
Wiley	6346	6828	6099	6214	9414

Table A.2

Use of packages at the University of Burgos.

Distributors	2006			2007			2008			2009			2010		
	SD	SL	W	SD	SL	W	SD	SL	W	SD	SL	W	SD	SL	W
Titles accessible	1752	1606	860	1848	4260	922	2359	3240	689	2456	3561	1974	1791	2553	1748
Titles unused	690	694	590	741	3748	653	1021	2650	443	1054	2945	1577	338	1849	1163
Titles used	1062	372	270	1107	512	269	1338	590	246	1402	616	397	1453	704	585
Core titles	378	51	71	388	64	74	506	67	74	560	76	98	648	81	128
Concentration rate (%)	35.59	13.70	26.29	35.04	12.50	27.50	37.81	11.35	30.08	39.94	12.33	24.68	44.59	11.50	21.88
Dispersion rate (%)	60.61	23.16	31.39	59.90	12.01	29.17	56.71	18.20	35.70	57.08	17.29	20.11	81.12	27.57	33.46

SD = ScienceDirect; SL = SpringerLink; W = Wiley.

Table A.3

Representativeness of preferred titles among total downloads at the University of Burgos.

	2006		2007		2008		2009		2010	
Total downloads	41,088		45,032		55,967		58,331		72,049	
Top 10	8756	21.31%	9068	20.13%	11,408	20.38%	11,108	19.04%	12,622	17.51%
Top 15	11,307	27.51%	11,618	25.79%	14,345	25.63%	14,325	24.55%	16,234	22.53%
Top 25	15,200	36.99%	15,394	34.18%	18,847	33.67%	18,945	32.47%	21,790	30.24%

Table A.4

Total downloads per supplier at the University of Leon.

	2006	2007	2008	2009	2010
ScienceDirect	66,825	68,491	110,027	62,121	77,778
SpringerLink	3063 ^a	7651	10,381	7349	10,792
Wiley	3330	4072	4929	4682	11,742

^a Up to June.

Table A.5

Use of packages at the University of Leon.

Distributors	2006			2007			2008			2009			2010		
	SD	SL	W	SD	SL	W	SD	SL	W	SD	SL	W	SD	SL	W
Titles accessible	2424	3041	578	2409	3354	602	2395	3354	690	2386	3354	745	2524	2703	1412
Titles unused	840	2656	299	398	2674	321	524	2535	374	844	2608	423	724	1783	682
Titles used	1584	385	279	1651	680	281	1871	819	316	1542	746	322	1800	920	730
Core titles	825	73	92	816	159	94	1376	185	116	744	159	102	940	212	229
Concentration rate (%)	52.08	12.66	32.97	49.42	23.38	33.45	73.54	22.58	36.70	48.24	21.31	31.67	52.22	23.04	51.69
Dispersion rate (%)	65.34	18.96	48.26	68.53	20.27	46.67	78.12	24.41	45.79	64.62	22.24	43.22	71.31	34.03	31.36

SD = ScienceDirect; SL = SpringerLink; W = Wiley.

Table A.6

Representativeness of preferred titles among total downloads at the University of Leon.

Total downloads	2006		2007		2008		2009		2010	
		73,218		80,214		125,337		74,152		100,312
Top 10	9891	13.50%	9984	12.44%	10,799	8.61%	15,770	21.26%	7453	7.42%
Top 15	12,744	17.40%	12,998	16.20%	14,304	11.41%	17,987	24.25%	10,484	10.45%
Top 25	17,091	23.34%	17,945	22.37%	20,048	15.99%	21,710	29.27%	15,277	15.22%

Table A.7

Total downloads per supplier at the University of Salamanca.

	2006	2007	2008	2009	2010
ScienceDirect	118,331	86,785	96,747	93,154	145,966
SpringerLink	9241	18,606	21,128	20,932	20,476
Wiley	17,088	17,515	18,479	22,270	31,783

Table A.8

Use of packages at the University of Salamanca.

Distributors	2006			2007			2008			2009			2010		
	SD ^a	SL	W	SD	SL	W	SD	SL	W	SD	SL	W	SD	SL	W
Titles accessible	697	578		2489	1152	602	2473	2201	690	2459	3561	1974	2172	2553	1748
Titles unused	216	209		699	0	181	577	943	279	521	2153	1103	351	1210	372
Titles used	481	369		1790	1152	421	1896	1258	411	1938	1408	871	1821	1343	1376
Core titles	196	192		1082	398	214	1243	463	219	1236	474	318	1214	455	550
Concentration rate (%)	40.74	52.03		60.44	34.54	50.83	65.55	36.80	53.28	63.77	33.66	36.50	66.66	33.87	39.97
Dispersion rate (%)	69.01	63.84		71.91	100	69.93	76.66	57.15	59.56	78.81	39.53	44.12	83.83	52.60	78.71

SD = ScienceDirect; SL = SpringerLink; W = Wiley.

^a No data.**Table A.9**

Representativeness of preferred titles among total downloads at the University of Salamanca.

Total downloads	2007		2008		2009		2010	
		122,906		136,354		136,356		198,225
Top 10	17,095	13.90%	19,359	14.19%	21,124	15.49%	15,176	7.65%
Top 15	21,486	17.48%	24,669	18.09%	26,531	19.45%	19,990	10.08%
Top 25	27,703	22.53%	31,727	23.26%	34,282	25.14%	27,052	13.64%

Table A.10

Total downloads per supplier at the University of Valladolid.

	2006	2007	2008	2009	2010
ScienceDirect	120,703	112,825	126,065	144,433	145,615
SpringerLink	–	9481	11,599	15,066	13,599
Wiley	12,461	10,323	11,244	12,422	21,428

Table A.11

Use of packages at the University of Valladolid.

Distributors	2006			2007			2008			2009			2010		
	SD	SL ^a	W	SD	SL	W	SD	SL	W	SD	SL	W	SD	SL	W
Titles accessible	2497		578	2494	2235	602	2485	2201	690	2468	2369	745	2163	2703	2051
Titles unused	728		192	693	1265	236	618	1068	289	611	1051	325	230	1416	1019
Titles used	1769		386	1801	970	366	1867	1133	401	1857	1318	420	1933	1287	1032
Core titles	1138		176	1099	247	174	1137	290	178	1044	394	199	1196	349	374
Concentration rate (%)	64.33		45.59	61.02	25.46	47.54	60.89	25.59	44.38	56.21	29.89	47.38	61.87	27.11	36.24
Dispersion rate (%)	70.84		66.78	72.21	43.40	60.79	75.13	51.47	58.11	75.24	55.63	56.37	89.36	47.61	50.31

SD = ScienceDirect; SL = SpringerLink; W = Wiley.

^a No data.**Table A.12**

Representativeness of preferred titles among total downloads at the University of Valladolid.

Total downloads	2007		2008		2009		2010	
	Downloads	%	Downloads	%	Downloads	%	Downloads	%
	132,629		148,908		171,921		180,642	
Top 10	12,490	9.41%	16,849	11.31%	11,615	6.75%	19,097	10.57%
Top 15	17,541	13.22%	21,701	14.57%	15,394	8.95%	25,538	14.13%
Top 25	24,980	18.83%	29,158	19.58%	21,110	12.27%	34,719	19.21%

Appendix B. Data on production and consumption

Table B.1

Growth rate for academic output at the Universities of Burgos and Leon.

Year	University of Burgos				University of Leon			
	Articles published		Growth rates		Articles published		Growth rates	
	WoS	Scopus	WoS	Scopus	WoS	Scopus	WoS	Scopus
2006	96	98	–	–	221	252	–	–
2007	132	134	27.27	26.86	254	263	12.99	4.18
2008	117	116	–12.82	–15.51	253	268	–0.39	1.86
2009	114	126	–2.63	7.93	262	291	3.43	7.90
2010	130	136	12.30	7.35	249	294	–5.22	1.02
2011	146	148	10.95	8.10	296	332	15.87	11.44

Table B.2

Growth rate for academic output at the universities of Salamanca and Valladolid.

Year	University of Salamanca				University of Valladolid			
	Articles published		Growth rates		Articles published		Growth rates	
	WoS	Scopus	WoS	Scopus	WoS	Scopus	WoS	Scopus
2006	557	503	–	–	485	441	–	–
2007	583	538	4.45	6.50	479	447	–1.25	1.34
2008	701	601	16.83	10.48	594	541	19.36	17.37
2009	656	621	–6.85	3.22	588	527	–1.02	–2.65
2010	720	654	8.88	5.04	587	555	–0.17	5.04
2011	756	685	4.76	4.52	648	619	9.41	10.33

Table B.3

Journals most often downloaded at the University of Burgos.

Title	2006	2007	2008	2009	2010	Total
<i>ScienceDirect</i>						
Analytica Chimica Acta	1055	846	1507	1137	1467	6012
Bioresource Technology	266	406	680	501	527	2380
Fluid Phase Equilibria	454	359	541	554	643	2551
Food Chemistry	596	1103	1832	2086	2334	7951
Journal of Chromatography A	467	763	1221	1128	1278	4857
Journal of Human Evolution	1510	852	1055	636	1369	6932
Journal of Membrane Science	579	683	926	787	600	3575
Meat Science	541	1196	757	1193	1011	4698
Soil Biology and Biochemistry	581	466	519	892	648	3106
Talanta	426	392	881	550	712	2961
Tetrahedron	707	664	872	990	674	3907
Tetrahedron Letters	1008	1135	1397	1165	1089	5794
<i>SpringerLink</i>						
Analytical and Bioanalytical Chemistry	119	173	152	161	183	788
Biology and Fertility of Soils	175	131	139	172	94	711
European Food Research and Technology	66	121	172	159	164	682
Experimental Mechanics	25	34	83	28	28	198
International Journal of Thermophysics	36	47	35	41	103	262
Journal of Solid State Electrochemistry	28	36	52	44	38	198
Journal of Solution Chemistry	26	35	34	48	35	178
Plant and Soil	109	37	161	177	61	545
<i>Wiley</i>						
Advanced Materials	166	80	60	119	90	515
Advanced Synthesis and Catalysis	244	226	189	232	95	986
American Journal of Physical Anthropology	482	424	509	279	932	2244
Angewandte Chemie International Edition	1213	1190	960	886	1003	5252
Chemistry-A European Journal	475	448	408	412	682	2425
Electroanalysis	226	210	252	102	211	1001
European Journal of Inorganic Chemistry	154	342	199	111	125	931
European Journal of Organic Chemistry	320	309	249	259	292	1429
International Journal of Osteoarchaeology	157	161	147	84	115	664
Journal of Applied Polymer Science	81	235	151	189	166	822
Journal of Polymer Science Part A: Polymer Chemistry	133	117	154	143	207	754
Journal of the Science of Food and Agriculture	112	176	142	202	187	819
Strategic Management Journal	190	298	178	118	121	905

Table B.4

Journals most often downloaded at the University of Leon.

Title	2006	2007	2008	2009	2010	TOTAL
<i>ScienceDirect</i>						
Animal Feed Science and Technology	764	1053	655	641	640	3753
Biochemical and Biophysical Research Communications	554	597	614	396	500	2661
Food Microbiology	568	519	481	367	662	2597
Forest Ecology and Management	893	710	734	338	576	3251
Small Ruminant Research	538	513	826	362	540	2779
Veterinary Parasitology	869	617	755	436	724	3401
Water Research	858	579	649	446	522	3054
<i>SpringerLink</i>						
Applied Microbiology and Biotechnology	95	314	337	273	422	1441
Euphytica	35	104	93	60	97	389
European Journal of Applied Physiology	154	592	704	420	703	2573
Hydrobiology	134	431	474	291	217	1547
Journal of Industrial Microbiology and Biotechnology	32	77	157	110	134	510
Plant Cell Reports	51	60	112	65	106	394
Plant Ecology	78	86	85	55	82	386
Theoretical and Applied Genetics (TAG)	31	134	231	163	204	763
<i>Wiley</i>						
Biotechnology and Bioengineering	126	119	71	150	108	574
Journal of the Science of Food and Agriculture	88	94	142	178	286	788

Table B.5

Journals most often downloaded at the University of Salamanca.

Title	2006	2007	2008	2009	2010	Total
<i>ScienceDirect</i>						
Analytica Chimica Acta	–	895	1274	1486	1366	5021
Biochemical and Biophysical Research Communications	–	1242	1728	1587	1280	5837
Bioorganic and Medicinal Chemistry Letters	–	790	772	1038	768	3368
Brain Research	–	1104	1165	998	1071	4338
Earth and Planetary Science Letters	–	615	850	679	886	3030
FEBS letters	–	1044	1217	1118	1057	4436
Food Chemistry	–	1069	1399	1632	1211	5311
Journal of Chromatography A	–	2685	2944	2325	2759	10,713
Lancet, The	–	1186	1564	1160	983	4893
Neuroscience	–	1086	1248	1218	1045	4597
Palaeogeography, Palaeoclimatology, Palaeoecology	–	805	893	932	883	3513
Phytochemistry	–	1928	1185	1464	1259	5836
Tetrahedron	–	2738	3955	4582	2242	13,517
Tetrahedron Letters	–	2516	2192	3469	1842	10,019
<i>SpringerLink</i>						
Analytical and Bioanalytical Chemistry	85	152	202	205	351	995
Applied Microbiology and Biotechnology	118	222	229	285	266	1120
Cellular and Molecular Life Sciences (CMLS)	179	217	243	293	238	1170
Current Genetics	168	179	212	158	123	840
European Food Research and Technology	73	170	440	139	146	968
Journal of Autism and Developmental Disorders	75	127	226	184	202	814
Plant Systematics and Evolution	81	124	173	134	128	640
Planta	128	177	192	165	198	860
<i>Wiley</i>						
Angewandte Chemie International Edition	1323	1541	1836	1876	1089	7665
Chemistry-A European Journal	381	477	362	387	612	2219
Electrophoresis	550	627	510	318	349	2354
European Journal of Organic Chemistry	331	548	439	411	417	2146
Hepatology	466	404	471	386	268	1995
International Journal of Cancer	314	365	570	404	354	2007
Journal of Comparative Neurology, The	688	524	458	425	363	2458
Proteomics	398	297	434	267	225	1621
Yeast	490	448	452	344	426	2160

Table B.6

Journals most often downloaded at the University of Valladolid.

Title	2006	2007	2008	2009	2010	Total
<i>ScienceDirect</i>						
Analytica Chimica Acta	–	946	1217	671	1573	4407
Bioresource Technology	–	1146	1530	1306	2551	6533
Chemical Engineering Science	–	1070	864	727	1284	3945
Fluid Phase Equilibria	–	1393	1717	1329	1858	6297
Food Chemistry	–	1459	2339	1414	2516	7728
Forest Ecology and Management	–	1254	2112	1190	1645	6201
Journal of Chromatography A	–	1307	1572	1047	1644	5570
Journal of Food Engineering	–	738	752	597	1241	3328
Journal of Membrane Science	–	1197	891	1006	1811	4905
Journal of Organometallic Chemistry	–	1178	1269	660	1093	4200
Journal of Supercritical Fluids, The	–	940	2142	1275	2230	6587
Polymer	–	913	796	749	1238	3696
Tetrahedron	–	906	961	939	1418	4224
Tetrahedron Letters	–	1084	1310	882	1564	4840
Water Research	–	877	802	759	1260	3698
<i>SpringerLink</i>						
Applied Microbiology and Biotechnology	–	100	141	252	204	697
Biotechnology Letters	–	70	85	159	97	411
European Food Research and Technology	–	77	92	181	177	527
General Relativity and Gravitation	–	90	119	114	103	426
Graefe's Archive for Clinical and Experimental Ophthalmology	–	92	129	79	155	455
Journal of Materials Science	–	114	140	93	85	432
Pflügers Archiv European Journal of Physiology	–	85	104	82	82	353

Table B.6 (continued)

Title	2006	2007	2008	2009	2010	Total
<i>Wiley</i>						
Advanced Materials	107	105	181	201	150	744
AIChE Journal	201	222	233	240	407	1303
Angewandte Chemie International Edition	1400	1305	1529	1227	1705	7166
Biotechnology and Bioengineering	225	204	187	241	200	1057
Chemistry-A European Journal	529	442	648	713	1081	3413
European Journal of Immunology	130	145	235	207	230	947
European Journal of Inorganic Chemistry	157	216	170	202	239	984
European Journal of Organic Chemistry	264	187	210	258	469	1388
Journal of Applied Polymer Science	569	347	303	319	549	2087
Strategic Management Journal	169	215	165	184	256	989

Table B.7

Journals with most articles included in Scopus and WoS at the University of Burgos (2006–2011).

Titles in Scopus	Articles
Journal of Physical Chemistry B	23
Analytica Chimica Acta	15
Food Chemistry	12
Journal of Organic Chemistry	11
European Journal of Inorganic Chemistry	10
Engineering Failure Analysis	10
Journal of Physics A Mathematical and Theoretical	10
Industrial and Engineering Chemistry Research	10
Journal of Chemical and Engineering Data	9
Journal of Polymer Science Part A Polymer Chemistry	9
Journal of Agricultural and Food Chemistry	8
Organic Letters	8
Meat Science	8
Journal of Human Evolution	7
Chemical Communications	7
Fluid Phase Equilibria	7
Talanta	7
Electroanalysis	6
Electrochemistry Communications	6
Electrochimica Acta	6
Physical Chemistry Chemical Physics	6
International Journal of Food Microbiology	6
Journal of Physical Chemistry A	6
Inorganic Chemistry	6
European Journal of Organic Chemistry	5
Physical Review B Condensed Matter and Materials Physics	5
Polyhedron	5
Chemical Engineering Journal	5
Revista Española de Financiación y Contabilidad	5
Sensors	5
Synlett	5
Analytical and Bioanalytical Chemistry	5
Journal of the Science of Food and Agriculture	5
Titles in WoS	Articles
Journal of Physical Chemistry B	23
Analytica Chimica Acta	17
Food Chemistry	12
Journal of Organic Chemistry	11
Journal of Physics A—Mathematical and Theoretical	10
Talanta	10
Engineering Failure Analysis	9
European Journal of Inorganic Chemistry	9
Journal of Chemical and Engineering Data	9
Journal of Polymer Science Part A—Polymer Chemistry	9
Meat Science	9
Journal of Agricultural and Food Chemistry	8
Organic Letters	8
Analytical and Bioanalytical Chemistry	7

(continued on next page)

Table B.7 (continued)

Titles in WoS	Articles
Chemical Communications	7
Electrochemistry Communications	7
Fluid Phase Equilibria	7
Industrial and Engineering Chemistry Research	7
Electroanalysis	6
Electrochimica Acta	6
Inorganic Chemistry	6
International Journal of Food Microbiology	6
Journal of Physical Chemistry A	6
Physical Review B	6
Chemical Engineering Journal	5
European Journal of Organic Chemistry	5
Journal of Human Evolution	5
Physical Chemistry Chemical Physics	5
Polyhedron	5
Sensors	5
Synlett	5

Table B.8

Journals with most articles included in Scopus and WoS at the University of Leon (2006–2011).

Titles in Scopus	Articles
Theriogenology	27
Journal of Dairy Science	27
Animal Feed Science and Technology	22
Lecture Notes in Computer Science Including Subseries Lecture Notes in Artificial Intelligence and Lecture Notes in Bioinformatics	22
Journal of Animal Science	20
Nutrición Hospitalaria	19
Atmospheric Research	19
Small Ruminant Research	15
Bioresource Technology	15
Microbiology	14
Fisioterapia	14
International Journal of Food Microbiology	13
Forest Ecology and Management	12
Reproduction in Domestic Animals	12
Meat Science	12
Fungal Genetics and Biology	11
Aquaculture	11
Spanish Journal of Agricultural Research	11
Lazaroa	10
Applied and Environmental Microbiology	9
Veterinary Journal	9
Journal of Biological Chemistry	9
IFAC Proceedings Volumes IFAC Papers On Line	9
Journal of Food Protection	8
Parasitology Research	8
Journal of Pineal Research	8
Titles in WoS	Articles
Journal of Dairy Science	30
Theriogenology	27
Animal Feed Science and Technology	24
Atmospheric Research	20
Journal of Animal Science	20
Itea-información Técnica Económica Agraria	19
Bioresource Technology	15
Meat Science	14
Microbiology-SGM	14
Nutrición Hospitalaria	14
Reproduction in Domestic Animals	14
Small Ruminant Research	14
Forest Ecology and Management	12
Fungal Genetics and Biology	12
International Journal of Food Microbiology	12
Spanish Journal of Agricultural Research	12
Aquaculture	11

Table B.8 (continued)

Titles in WoS	Articles
Journal of Biological Chemistry	10
Veterinary Journal	10
Applied and Environmental Microbiology	9
Research in Veterinary Science	9
Journal of Food Protection	8
Journal of Pineal Research	8
Parasitology Research	8
Applied Microbiology and Biotechnology	7
Fems Microbiology Letters	7
Food Microbiology	7
Journal of Agricultural Science	7
Molecular Microbiology	7

Table B.9

Journals with most articles included in Scopus and WoS at the University of Salamanca (2006–2011).

Titles in Scopus	Articles
Physical Review D Particles Fields Gravitation and Cosmology	53
Journal of Applied Physics	33
Tetrahedron	32
Plos One	26
Physical Review b Condensed Matter and Materials Physics	25
International Journal of Systematic and Evolutionary Microbiology	22
Journal of Chromatography a	21
Journal of Biological Chemistry	20
Physical Review c Nuclear Physics	20
Psicothema	19
Applied Physics Letters	19
Food Chemistry	18
Leukemia	16
Chemical Engineering Journal	16
Optics Express	16
Industrial and Engineering Chemistry Research	15
Journal of Magnetism and Magnetic Materials	15
Applied Clay Science	14
Neuroscience	14
Journal of Agricultural and Food Chemistry	14
Veterinary Parasitology	14
Cytometry Part B Clinical Cytometry	13
Analytica Chimica Acta	13
Journal of Chemical Physics	13
Talanta	13
Revista de Educación	13
Titles in WoS	Articles
Physical Review D	49
Journal of Applied Physics	37
Tetrahedron	33
Blood	32
Plos One	31
Haematologica – the Hematology Journal	27
Physical Review B	27
International Journal of Systematic and Evolutionary Microbiology	24
Journal of Biological Chemistry	24
Leukemia	24
Journal of Chromatography A	21
Psicothema	21
British Journal of Hematology	20
Physical Review C	20
Applied Physics Letters	19
Food Chemistry	18
Optics Express	18

(continued on next page)

Table B.9 (continued)

Titles in WoS	Articles
Analytica Chimica Acta	17
Journal of Clinical Oncology	17
Molecular Biology of the Cell	17
Chemical Engineering Journal	16
Journal de Educacion	16
Cytometry Part B – Clinical Cytometry	15
Journal of Agricultural and Food Chemistry	15
Journal of Magnetism and Magnetic Materials	15

Table B.10

Journals with most articles included in Scopus and WoS at the University of Valladolid (2006–2011).

Titles in Scopus	Articles
Physical Review B Condensed Matter and Materials Physics	45
Conference Proceedings Annual International Conference of the IEEE Engineering in Medicine and Biology Society IEEE Engineering in Medicine and Biology Society Conference	42
Journal of Chemical Physics	39
Journal of Supercritical Fluids	34
Journal of Physical Chemistry A	24
Organometallics	23
Journal of Chemical and Engineering Data	21
Inorganic Chemistry	19
Journal of Physics a Mathematical and Theoretical	18
Physical Review a Atomic Molecular and Optical Physics	18
Nutrición Hospitalaria	18
Physical Chemistry Chemical Physics	17
Journal of Geophysical Research D Atmospheres	17
European Review for Medical and Pharmacological Sciences	17
Chemical Physics Letters	17
Bioresource Technology	16
Industrial and Engineering Chemistry Research	16
Dalton Transactions	16
Journal of Chromatography a	16
Annals of Nutrition and Metabolism	16
Chemistry A European Journal	16
Journal of Applied Physics	15
Journal of the American Chemical Society	14
Óptica Pura y Aplicada	13
Journal of Organometallic Chemistry	13
Investigación Agraria Sistemas y Recursos Forestales	13
Titles in WoS	Articles
Physical Review B	46
Journal of Chemical Physics	37
Journal of Supercritical Fluids	36
Nutrición Hospitalaria	23
Journal of Chemical and Engineering Data	22
Organometallics	22
Journal of Physical Chemistry a	21
Inorganic Chemistry	20
Journal of Physics A-Mathematical and Theoretical	20
Chemical Physics Letters	19
European Review for Medical and Pharmacological Sciences	19
Physical Review A	19
Journal of Chromatography a	18
Physical Chemistry Chemical Physics	18
Annals of Nutrition and Metabolism	17
Chemistry – a European Journal	17
Dalton Transactions	17
Bioresource Technology	16
Journal of Applied Physics	16
Medicina Clínica	16
Behavioral Psychology – Psicología Conductual	15
Industrial and Engineering Chemistry Research	15
Journal of Chemical Thermodynamics	15

Table B.10 (continued)

Titles in WoS	Articles
Journal of Geophysical Research-atmospheres	15
Boletín de la Asociación de Geógrafos españoles	14
Investigative Ophthalmology and Visual Science	14
Journal of Applied Polymer Science	14
Journal of Organometallic Chemistry	14

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